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Wright Site welcomes Gen. Martin

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — AFMC Commander Gen. Gregory S. Martin, saluting on left, as he entered the Sensors Directorate's facilities. Gen. Martin spent Monday, Dec. 15 visiting AFRL's Wright Site technical directorates. The visit concluded with a commander's call, in which Gen. Martin elaborated on his strategy of "Survive, Know the Rules, Plan Ahead and Win". Accompanying Gen. Martin on his visit from left to right are AFRL Vice Commander Col. David Walker, AFRL Commander Maj. Gen. Paul D. Nielsen, and Sensors Directorate Deputy Director Col. Samuel K. Ryals. (Air Force photo by Jeremy D. Patton)

Season's greetings from AFRL Public Affairs

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Commander
Maj. Gen. Paul D. Nielsen

Director of Public Affairs
Deborah Csutoras

Production Editor
Jill Bohn

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Sensors names new deputy

by Grace Janiszewski, Sensors Directorate

Col. Samuel K. Ryals

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — A pilot with more than 4,300 hours of flight time in more than 100 types of aircraft has been named deputy director of Air Force Research Laboratory's Sensors Directorate. Col. Samuel K. Ryals said he plans to use his flight experience to help move new technology directly to the warfighter more rapidly.

In addition, Ryals said helping others, increasing teamwork and mentoring are his major goals. "Mentors are leaders, and leaders are mentors," he said. "If we're not mentoring, then I think we're shortchanging the Air Force in the long run."

Before this assignment, Ryals was director of Aeronautical Systems Center's Special Operations Forces System Program Office.

A 1975 graduate of the Air Force Academy, Ryals has served in a variety of assignments including four overseas tours, and an assignment as a replacement-training unit U-2/TR-1 and T-38 instructor pilot. In 1985, he was selected for Air Force Test Pilot School at Edwards AFB, Calif. He was a test pilot on 12 developmental aircraft programs, to include source selection and first flight test on the T-1A Jayhawk and the C-18D cruise missile mission control aircraft. He also served as an instructor pilot at the Air Force Test Pilot School.

Having served at Wright-Patterson for two previous tours, Ryals said serving as deputy director is a wonderful way to conclude his military service. "The majority of my career has been in the acquisition and operational fields," he said. "It is exciting now to be involved in the discovery phase, the research that leads to the improvements delivered to the war fighter."

His career has included command of the AC-130U Spectre Gunship program, the Integrated Tactical Warning and Attack Assessment Division, the Space and C3I Management Division at McClellan Air Force Base, Calif., and the F-117 program, moving the program office to Wright-Patterson in July 1998. During that tour he won the secretary of the Air Force for acquisition's Lightning Bolt award, John J. Welch Jr. trophy, and both the vice presidential Hammer Award and the David Packard award for acquisition excellence. @

Additional newsletter stories online at

http://www.afrl.af.mil/news/index.htm

VA researchers develop duct with composite materials

by Melissa Withrow, Air Vehicles Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — Engineers can now use composite lay-up techniques with production equipment to build a single-piece diffusing duct using 100% composite material without fasteners. The resulting duct is lighter, stronger, and easier to manufacture than current designs. This technology will be applicable and available to a wide array of unmanned and manned air vehicles, including the Joint Unmanned Combat Air System (J-UCAS).

Air Vehicles Directorate scientists collaborated with Lockheed Martin Advanced Development Programs to successfully demonstrate Structurally Integrated Compact Inlet Technology (STRICT). Using automatic composite fiber placement and other state-of-the-art manufacturing techniques, they produced a highly compact, fully offset, single piece diffusing duct with integrated flow control devices and sensors.

Scientists overcame significant challenges while manufacturing this component. Small turn radii and lateral curvature were necessary in the duct structure for compactness but could hamper structural flexibility. The duct was manufactured as a single piece for structural integration, simplicity, and the elimination of conventional fasteners. This requirement made necessary the use of a large fiber placement machine that could reach into surfaces to create the duct.

This duct was developed by the Air Vehicles Directorate using 100 percent composite materials. The new design meets aerodynamic performance requirements. (Air Force photo)

The STRICT program was conceived to demonstrate an inlet duct enabled by flow control technology that not only satisfied aerodynamic performance requirements but was also produced using advanced composites technology. By using air flow control, STRICT allows the development of ducts that are shorter than those previously used, thus allowing smaller UAV designs. The composites technologies employed were developed under the Air Vehicles Directorate's Composites Affordability Initiative and Inlet Aerostrucutral Integration programs.

The system produced in this project is sized to fit the X-45A Unmanned Combat Air Vehicle program (UCAV) engine, yet is applicable to a wide array of unmanned and manned air vehicles. @

New simulation, modeling tools enable aerial refueling

by William Blake, Air Vehicles Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — As the Air Force's reliance on Unmanned Aerial Vehicles (UAV) and Unmanned Combat Aerial Vehicles (UCAV) increases, so do its simulation and modeling requirements.

Operations of UAV and UCAV groups will attain performance benefits, and/or perform in-flight refueling. Since human operators will be located in remote air or ground stations, advanced flight control algorithms need to be developed. To facilitate the development of robust control laws and reduce project risk, the Air Force requires advanced simulation and modeling capabilities for air vehicles in close formation.

Bihrle Applied Research Inc. (BAR) won Phase I and Phase II SBIR contracts to improve the state of the art in developing simulations of air vehicles flying in close formation. In this effort, BAR is addressing Air Force needs in two areas, flight model development and simulation tools. Models for close formation flight have historically been based on computational aerodynamics. While this approach is good for preliminary estimates, it results in over-simplification of aerodynamic phenomena.

Over-simplification often leads to the development of low-fidelity modeling. During its Phase II work, BAR developed test techniques, apparatus, and data acquisition software that can be used during wind tunnel tests to measure aircraft aerodynamic characteristics while in close formation. Data from wind tunnel tests utilizing this improved technology can be used to refine preliminary computational estimates and refine algorithms. It can also be implemented directly into simulation models.

The second issue BAR addressed during Phase II is the need for advanced simulation tools for close formation flight. Based on its D-Six PC-Based simulation environment (a product of an SBIR Phase I in 1995), BAR is developing a comprehensive simulation capability that allows users to load multiple independent simulations into a single application. This capability allows the Air Force to develop a single flight model and reuse it during a single simulation session. Using multiple simulations loaded into the environment, an engineer may apply a global control algorithm to a simulated formation flight scenario. Until now, development sessions like these have required multiple simulations running on multiple computers or a single complex simulation structure. The advanced simulation capability being developed by BAR will greatly simplify the complex task of modeling multiple vehicles, while requiring less development time for engineers.

This technology is being used to enable aerial refueling of the UCAV (X-45) under the AAR (Autonomous Aerial Refueling) program. Wind tunnel testing has been conducted on a generic UAV behind a KC-135R (simulating USAF refueling) and behind an F-18 (simulating Navy "buddy" refueling). @

Information Directorate engineer sails aboard carrier

by Fran Crum, Information Directorate

ROME, N.Y. — An Air Force Research Laboratory engineer recently hit the high seas as part of his research responsibilities.

Marc J. Pitarys, an electronics engineer, in the Embedded Information Systems Engineering Branch of AFRL's Information Directorate, visited the aircraft carrier USS John C. Stennis (CVN 74) as part of his duties as technical director of the X-45 Joint Unmanned Combat Air Systems (J-UCAS) Program.

The J-UCAS program is a joint DARPA/Air Force/Navy effort to demonstrate the technical feasibility, military utility and operational value for a networked system of high performance, weaponized unmanned air vehicles to effectively and affordably prosecute 21st century combat missions. J-UCAS program combines the efforts that were previously known as the DARPA/USAF Unmanned Combat Air Vehicle (UCAV) and the DARPA/USN Naval Unmanned Combat Air Vehicle (UCAV-N) programs.

Pitarys sailed onboard the ship during training exercises in the Pacific to gain familiarity with carrier suitability issues and understand carrier airspace, mission, and flight deck operations.

The J-UCAS program will conduct demonstrations related to operations in carrier controlled airspace, catapult and recovery, and flight deck operations, according to Pitarys.

"Part of our effort is development of naval demonstrators in addition to land-based aircraft," Pitarys said.

Pitarys observed flight operations in the Landing Signal Officer's platform and on the flight deck. He also observed command and control operations in the Stennis' Primary Flight Control, where the air commander controls flight operations within five miles of the carrier. @

Dayton-area schools happy to receive donations from SN

by Sarah Hubbard, Sensors Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — As the Air Force Research Laboratory's Sensors Directorate updates their computer systems, local schools update as well. School districts and private parochial schools within Montgomery, Clark, Greene, Butler, Warren, Miami, Darke and Preble counties have received more than 150 pallets of computer components donated by AFRL.

"Every three years, each computer within the Sensors Directorate is replaced so our scientists and engineers can work on the most up-to-date equipment," said Grace Janiszewski, program coordinator.

The Pentium I and II computers being replaced are given to the school districts for math and science purposes in the classrooms.

"The computer systems donated to us have allowed us to expand our technology classes," said Jack McIntosh, Technology Director of Northridge Local School District. "They have also expanded the number of opportunities that we can offer students and increased the number of students served."

The directorate started the year-old program as incentive encouraging students to become more interested in math and science-related fields. The students can use the computers, or they can take them apart and study the parts of the computer, Janiszewski said.

"We use the computers in our A+ and Cisco classes," McIntosh said. "In these classes, the students take the computers apart and rebuild them and, if they successfully complete the class, they get to take the computers they have built home with them."

Northridge Local School District also has a community outreach program that tutors students. The computers are a great resource for the kids being tutored, said McIntosh.

And it's not just the large school districts that benefit from this program. Our Lady of the Rosary School is a small private institution, kindergarten through eighth grade, located in old north Dayton.

"The donations of the computer systems and parts will allow us to offer a broader technology base for each of our students" said Mrs. Cindy Todd, Rosary Computer Lab teacher. "We have even been able to form a 'Programming Club' and some of the students are learning how to build and troubleshoot computers. The students learn what is involved in the assembly of the computer and what is involved in the software installation."

A 'Patch Panel' is utilized to connect multiple computers or servers together using an Ethernet cable. Northridge High School students are provided a bare 'Patch Panel' and they must wire the Patch Panel. To verify their work two or more computers must communicate with each other. (Air Force photo)

"Once we have received a response from the interested districts, I email the inventory list out to everyone and it is first come, first serve. It is a very fair process that allows all schools to get a chance to put in their requests," Janiszewski said.

Teachers from the participating school districts say their classes benefit greatly from the computers.

"The people at AFRL were extremely helpful and generous about helping us in any way possible," McIntosh said. "The staff here at Northridge greatly appreciates this opportunity to expand our technology department, as I am sure other schools do as well." @

Air Force, NASA celebrate rocket engine milestones

as submitted by the Propulsion Directorate

EDWARDS AIR FORCE BASE, Calif. — The U.S Air Force, NASA, and two prime aerospace contractors have successfully completed testing of two key rocket engine components.

Testing of a new, liquid-hydrogen turbopump and a unique oxidizer preburner is part of a program called the Integrated Powerhead Demonstrator (IPD). The program is a joint venture between the Integrated High Payoff Rocket Propulsion Technology program, managed for the Department of Defense by the U.S. Air Force Research Laboratory's Propulsion Directorate at Edwards Air Force Base, Calif. and NASA's Next Generation Launch Technology program, managed for the Agency at the Marshall Space Flight Center in Huntsville, Ala.

Both tests are part of component-level, risk-reduction studies, intended to lead to development of a first of its kind hydrogen-fueled, full-flow, staged-combustion rocket engine. The engine will use preburners for both oxygen-rich and hydrogen-rich staged combustion. This will help the rocket engines operate at cooler temperatures during flight while achieving higher engine efficiencies and reducing their exhaust emissions.

"Completion of these tests moves us two steps closer to full-scale, integrated testing of the entire IPD system," said Garry Lyles, manager of the Next Generation Launch Technology program, which manages the IPD project for NASA. "America's future in space hinges on cutting-edge technology development, and together with our Air Force and industry partners, we're focused on creating a more reliable, robust engine system."

The team's integrated system testing is scheduled to begin in late 2004 at NASA's Stennis Space Center near Bay St. Louis, Miss.

The liquid-hydrogen fuel turbopump was developed for the Air Force and NASA by the Rocketdyne Propulsion and Power division of the Boeing Company of Canoga Park, Calif. The last of the turbopump test series, conducted at the Stennis Space Center, was completed Oct. 29.

The turbopump is designed to provide high-pressure hydrogen to the rocket engine thrust chamber, enabling the combustion process and generating thrust. The turbopump extracts energy from hot gases, which are generated by the fuel preburner and flow through the turbine, causing the turbopump rotor to spin at more than 50,000 rpm. As the rotor spins, an impeller attached to the other end of the shaft pumps the hydrogen to pressures greater than 6,600 psi. These high pressures are necessary to generate the 3,000-psi combustion gases in the thrust chamber, which expand through the chamber and nozzle to produce 250,000 pounds of thrust.

The design and technologies of the fuel turbopump address key life limitations of current reusable rocket engines, and is intended to achieve a lifespan goal of 200 flight missions and 100 flights between periods of engine refurbishment — 10 times the current capability of reusable rocket engines.

"We are very pleased with the results of the turbopump testing," said Don McAlister, IPD program manager at Boeing Rocketdyne. "We've met all our objectives and we've learned valuable lessons for future rocket engine design and testing. With the turbopumps well characterized, we can now move confidently into engine system testing next year."

Testing of the oxidizer preburner was conducted by component designer Aerojet Corp. at its Sacramento, Calif. facilities. That test series was completed Oct. 28.

The oxidizer preburner — which initiates the combustion process — is designed to generate oxygen-rich steam for use by the oxygen turbopump's turbine. The preburner burns a large quantity of liquid oxygen with a small quantity of hydrogen to produce this steam, which then mixes with additional hydrogen fuel to be burned in the main combustion chamber.

The preburner is the first flight-capable, oxygen-rich preburner developed in the United States for a large-scale engine. The use of oxygen-rich steam to power the oxygen turbopump is intended to dramatically increase safety of engine system operation, limiting seal failure between the pump and the turbine that could leak extremely hot gases into the turbine and cause them to burn prematurely.

"We are very excited about the operating characteristics demonstrated during the preburner testing," said Robert Werling, project manager for Aerojet. "They provided the thermal environments required to meet the extended turbine life goals, while providing the power necessary to realize the performance goals of the integrated engine system."

The Integrated Powerhead Demonstrator program is already seeing technology application as the cornerstone of NASA's Next Generation Launch Technology program, which seeks to provide safe, dependable, cost-cutting technologies for future space launch systems, increasing engine operability and leading to aircraft-like flight operations.

The Integrated Powerhead Demonstration program is an important part of the Department of Defense's Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, which seeks to double the performance and capability of today's state-of-the-art rocket propulsion systems while decreasing costs associated with military and commercial access to space. @

Directed Energy completes assessment of imaging laser

by Eva Hendren, Directed Energy Directorate

KIRTLAND AIR FORCE BASE, N.M. — An environmental assessment was completed in November for an imaging laser program that will produce high-resolution images of space objects. The Air Force Research Laboratory's Directed Energy Directorate and Trex Enterprises of San Diego, Calif., in an educational partnership agreement with the New Mexico Institute of Mining and Technology, will begin program construction next year.

An environmental impact assessment released for public comment November 24th declared that the program would pose minimal short-term and no long-term impacts to the environmental condition of the area. The possible sites proposed, near White Sands Missile Range in Socorro, New Mexico, were tested through eleven broad environmental issue classes to determine potential impacts.

The area assessment included two possible sites, one within the Energetic Materials Research and one at White Sands Missile Range. The broad groups listed in the report included air quality, noise, water resources, biological resources, cultural resources, socioeconomics, transportation, safety and occupational health, geology and soils resources, hazardous materials and waste, and land use. The assessment included construction and working impacts of two building structures, the heliostat array, and associated infrastructure such as roads, electrical power, telephone, water, and sewer. In all categories, the results of the tests listed either no impact or negligible impact.

The program, Geo Light Imaging National Testbed, would enable researchers to image objects such as satellites from the ground with the precision and resolution equivalent to a 100-meter telescope. @

Net Index

Due to the number of submissions we receive, some sections of *news@afrl* are available exclusively on-line. The on-line version of the newsletter allows users to view the AFRL corporate calendar, news releases generated by AFRL headquarters, operating instructions, L@b L@urels and Roundups sections.

The L@b L@urels section of the electronic newsletter is dedicated to members of Air Force Research Laboratory who receive awards and honors. The Roundups section of the electronic newsletter keeps Air Force Research Laboratory employees informed about contracts AFRL has awarded. Below is an index of articles one can find in each of these on-line sections.

L@b L@urels

- **88th Security Forces honors VA employee**
- **DE employees receive assortment of awards**
- **Three from AFRL earn engineering awards**

Roundups

- **Rome awards $1.2M contract to BBNT Solutions**

To view the full text of these and other articles visit the *news@afrl* page on the Internet at http://extra.afrl.af.mil/news/index.htm.
To submit L@b L@urels or Roundups from your directorate, send a query to AFRL Public Affairs at:

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DARPA, IF Directorate demonstrate NEST technology

by Fran Crumb, Information Directorate

ROME, N.Y.— New networked sensor fusion technology was demonstrated in September by the Defense Advanced Research Projects Agency (DARPA) with support from the Air Force Research Laboratory's (AFRL) Information Directorate.

The demonstration at the McKenna Military Operations in Urban Terrain site at Ft. Benning, Ga. showed sensors able of pinpointing the location of a shooter within one meter. The Network Embedded Systems Technology (NEST) field experiments were sponsored by the Information Exploitation Office of the Defense Advanced Research Projects Agency (DARPA).

Dr Vijay Raghavan, DARPA/IXO program manager, conducted this successful demonstration. Juan Carbonell and Stephen Benning of the Information Systems Division, Wright-Patterson Air Force Base, Ohio, represented the Information Directorate.

The goal of the NEST program is "fine-grain" fusion of physical and information processes. The quantitative target is to build dependable, real-time, distributed, embedded applications comprising 100 to 100,000 simple computing nodes. The nodes will include physical and information system components coupled by sensors and actuators.

"This initiative is inspired by extraordinary advances in micro-sensors, micro-electronics, advanced sensor fusion algorithms, self-localization technologies and information technologies," Carbonell said. "NEST is advancing capabilities in networked sensor technologies, hardware, software and communications. The long-term vision is an intelligent, web-centric distribution and fusion of sensor information that will greatly enhance the situational awareness of warfighters."

The system demonstrated was accurate to within one meter and had a latency of less than a half second. The system was even able to show the difference between shots being taken by a soldier while kneeling or standing up.

"Overall, the demonstrations were a complete success," Raghavan said. "There were no problems with any of the demonstrations and positive feedback was received from the observers. There is strong interest for maturing the shooter localization technology into a system that can quickly be transitioned into the field." @